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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/735,845	12/16/2003	Chih-Chao Yang	20140-00314-US	3180

30678 7590 09/11/2007
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EXAMINER	
TRAN, THANH Y	

ART UNIT	PAPER NUMBER
2822	

MAIL DATE	DELIVERY MODE
09/11/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/735,845	CHIH-CHAO YANG	
	Examiner	Art Unit	
	Thanh Y. Tran	2822	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *01/04/07*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,3-11 and 24-29* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,3-11 and 24-29* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claims 1, 3, 6-7, 9-11, 24, 26 and 28-29 are rejected under 35 U.S.C. 102(e) as being anticipated by Shimizu et al (2004/0004287).

As to claim 1, Shimizu et al discloses in figure 4 a structure and a corresponding method of making an interconnect structure comprising: providing an interconnect copper line (12a) (see paragraph [0072], "copper of wiring pattern" 12a) in a dielectric trench (trench of dielectric/ "insulating film" 10), wherein the interconnect copper line (12a) is in contact with a cap layer (15); depositing a sacrificial layer (35) on the cap layer (15); depositing an interlayer dielectric ("interlayer insulating film" 16) on the sacrificial layer (35); forming a trench (as indicated at 18 in figure 3) and a via (as indicated at 19 in figure 3) in the interlayer dielectric (16), wherein the via bottom extends to the sacrificial layer (35); and removing a portion of the cap layer (15) and the sacrificial layer (35) proximate to the bottom surface of the via (see figure 4), wherein the removed portions of the cap layer (15) and the sacrificial layer (35) deposit predominantly along the lower sidewalls of the via.

As to claims 3 and 26, figure 4 of Shimizu et al shows the deposition of a barrier layer (a barrier layer is an outer layer formed along the sidewalls of trench 18 and via 19 as indicated at

12A in figure 5D) on upper and lower sidewalls and bottom surface of the trench (as indicated at 18 in figure 3) and via (as indicated at 19 in figure 3) in the interlayer dielectric (16).

As to claims 6 and 28, figure 4 of Shimizu et al shows deposition of a metal liner or a seed layer (a seed layer is an inner layer formed along the sidewalls of trench 18 and via 19 as indicated at 12B in figure 5D) in contact with the barrier layer (a barrier layer is an outer layer formed along the sidewalls of trench 18 and via 19 as indicated at 12A in figure 5D).

As to claim 7, Shimizu et al discloses in figure 4 a structure and a corresponding method of making an interconnect structure, wherein the sacrificial layer (35) is a material selected from the group consisting of silicon nitrides, and silicon carbides.

As to claim 9, Shimizu et al discloses in figure 4 a structure and a corresponding method of making an interconnect structure, wherein the provided the interconnect copper line (12a) (see paragraph [0072], "copper of wiring pattern" 12a) and the cap layer (15) are recessed in the dielectric trench (trench of dielectric/ "insulating film" 10).

As to claims 10 and 25, Shimizu et al discloses in figure 4 a structure and a corresponding method of making an interconnect structure, wherein the sacrificial layer (35) is recessed in the dielectric trench (trench of dielectric/ "insulating film" 10).

As to claims 11 and 29, Shimizu et al discloses in figure 4 a structure and a corresponding method of making an interconnect structure, further comprising planarizing the sacrificial layer (35) to a top surface of the dielectric trench (trench of dielectric/ "insulating film" 10).

As to claim 24, Shimizu et al discloses in figure 4 a structure and a corresponding method of making an interconnect structure comprising: providing an interconnect conductive line (12a)

in a dielectric trench (trench of dielectric/"insulating film" 10), wherein the conductive line (12a) is in contact with a cap layer (15) are recessed in the dielectric trench; depositing a sacrificial layer (35) on the cap layer (15); depositing an interlayer dielectric ("interlayer insulating film" 16) on the sacrificial layer (35); forming a trench (as indicated at 18 in figure 3) and a via (as indicated at 19 in figure 3) in the interlayer dielectric (16), wherein the via bottom extends to the sacrificial layer; and removing a portion of the cap layer (15) and the sacrificial layer (35) proximate to the bottom surface of the via (19), wherein the removed portions of the cap layer (15) and the sacrificial layer (35) deposit predominantly along the lower sidewalls of the via.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Shimizu et al (U.S 2004/0004287) in view of the admitted prior art (figures 1A-1C).

As to claim 4, Shimizu et al does not disclose a step of removing of a portion of the barrier layer at the bottom surface of the via, wherein the removed portions of the barrier layer deposit predominantly along the lower sidewalls of the via.

The admitted prior art (figures 1A-1C) discloses a step of removing of a portion of the barrier layer (a barrier layer 16) at the bottom surface of a via (15), wherein the removed portions of the barrier layer (16) deposit predominantly along the lower sidewalls of the via (15).

Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to modify the apparatus and a corresponding method of Shimizu et al by having a step of removing of a portion of the barrier layer at the bottom surface of the via, wherein the removed portions of the barrier layer deposit predominantly along the lower sidewalls of the via as taught by the admitted prior art (figures 1A-1C) for protecting the sidewalls of the trench and via of the apparatus.

5. Claims 5 and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shimizu et al (U.S 2004/0004287) in view of Spencer et al (U.S. 6,060,019).

As to claims 5 and 27, Shimizu et al does not disclose a structure and a corresponding method, wherein removing a portion of the cap layer and the sacrificial layer is conducted by a gaseous ion bombardment.

Spencer et al discloses in col. 2, lines 27-38 a method of using a gaseous ion bombardment for removing the surface layers of the material. Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to modify the structure and the corresponding method of Shimizu et al by using a gaseous ion bombardment for removing the surface layers of the material as taught by Spencer et al for preventing the damage to the substrate or the structure.

6. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Shimizu et al (U.S 2004/0004287) in view of Lee et al (U.S. 2003/0104704).

As to claim 8, Shimizu et al does not disclose a structure and a corresponding method, wherein the sacrificial layer is a material selected from the group consisting of at least one of tantalum nitride, tantalum, titanium silicon nitride, titanium, tungsten nitride and tungsten.

Lee et al discloses in figure 3A a structure and a corresponding method, wherein the sacrificial layer (63A) is a material selected from the group consisting of at least one of tantalum nitride, tantalum, titanium silicon nitride, titanium, tungsten nitride and tungsten (see "tungsten" material used for sacrificial layer (63A) in paragraph [0066]). Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to modify the structure and corresponding method of Shimizu et al by using tungsten material for a sacrificial layer as taught by Lee et al for providing an etching gas layer.

Response to Arguments

7. Applicant's arguments filed 01/04/2007 have been fully considered but they are not persuasive.

Applicant argued that Shimizu does not teach or suggest a step of removing a portion of the cap layer and the sacrificial layer proximate to the bottom surface of the via, wherein the removed portions of the cap layer and the sacrificial layer deposit predominantly along the lower sidewalls of the via.

In response, the examiner disagrees with applicant's argument because Shimizu et al clearly discloses in figures 3-4 at least a portion of the cap layer (15) and the sacrificial layer (35) are removed proximate to the bottom surface of the via (18) (see figure 4), wherein the removed portions of the cap layer (15) and the sacrificial layer (35) deposit predominantly along the lower sidewalls of the via (18).

Conclusion

8. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Contact Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanh Y. Tran whose telephone number is (571) 272-2110. The examiner can normally be reached on M-F (9-6:30pm).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Zandra Smith, can be reached on (571) 272-2429. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

TYT

Zandra V. Smith
Supervisory Patent Examiner
4 Sept. 2007